



Effects of Mercury on SCR-catalysts

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Control**

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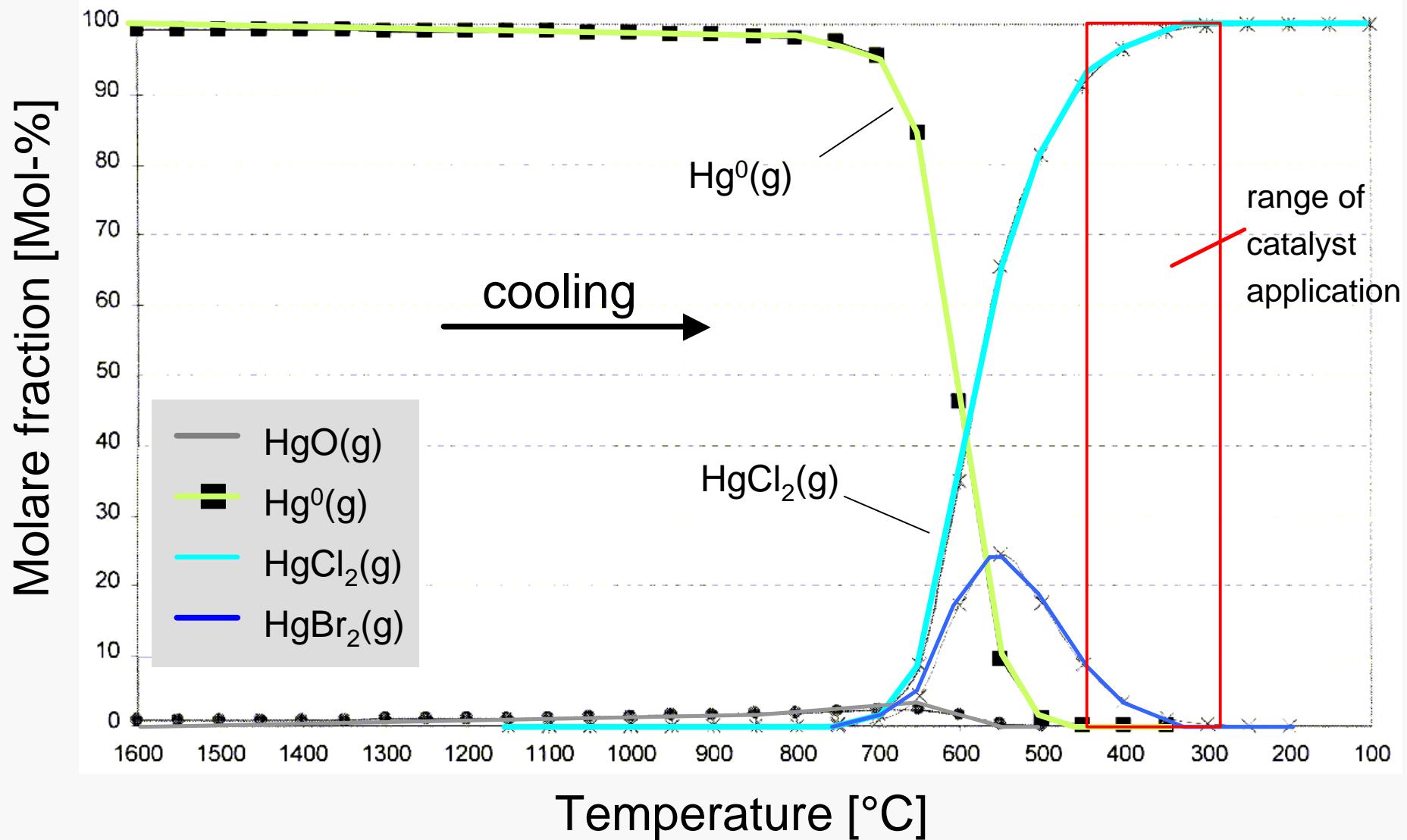
-  Introduction
-  State of Knowledge
-  Tail-end Application of SCR
 - dynamic behavior of mercury
-  High-dust Application of SCR
 - mercury oxidation
-  Conclusion



Prediction of Hg-species with ASPEN PLUS®



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[IVD, Martel 2000]



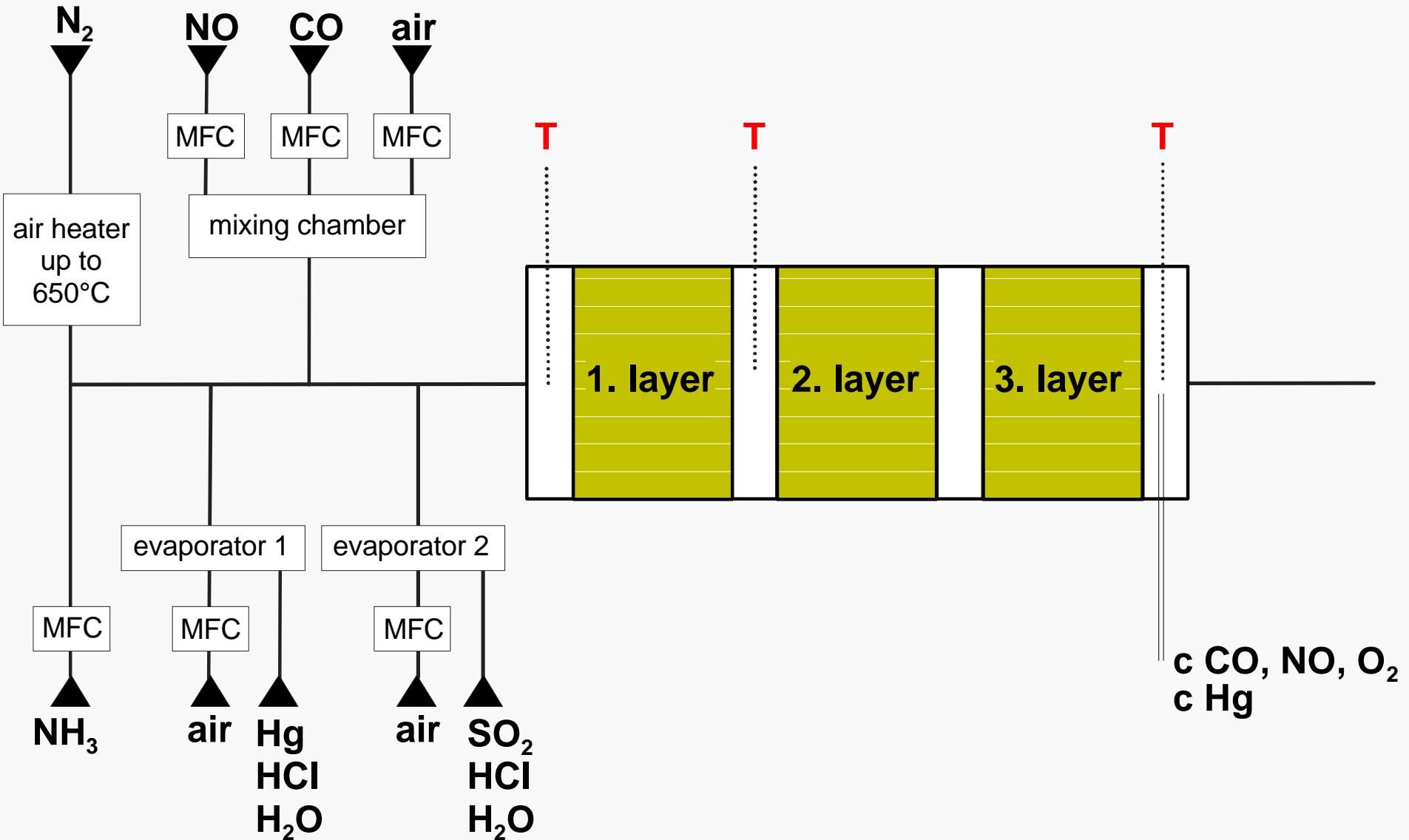
- SCR-DeNOx-catalysts (Typ Ti/V) have been reported to oxidize mercury:
 - oxidation almost complete for bituminous coals
 - oxidation incomplete for some sub-bituminous coals
 - sometimes bad mass balance closures



Test Facility - Catalytic Unit



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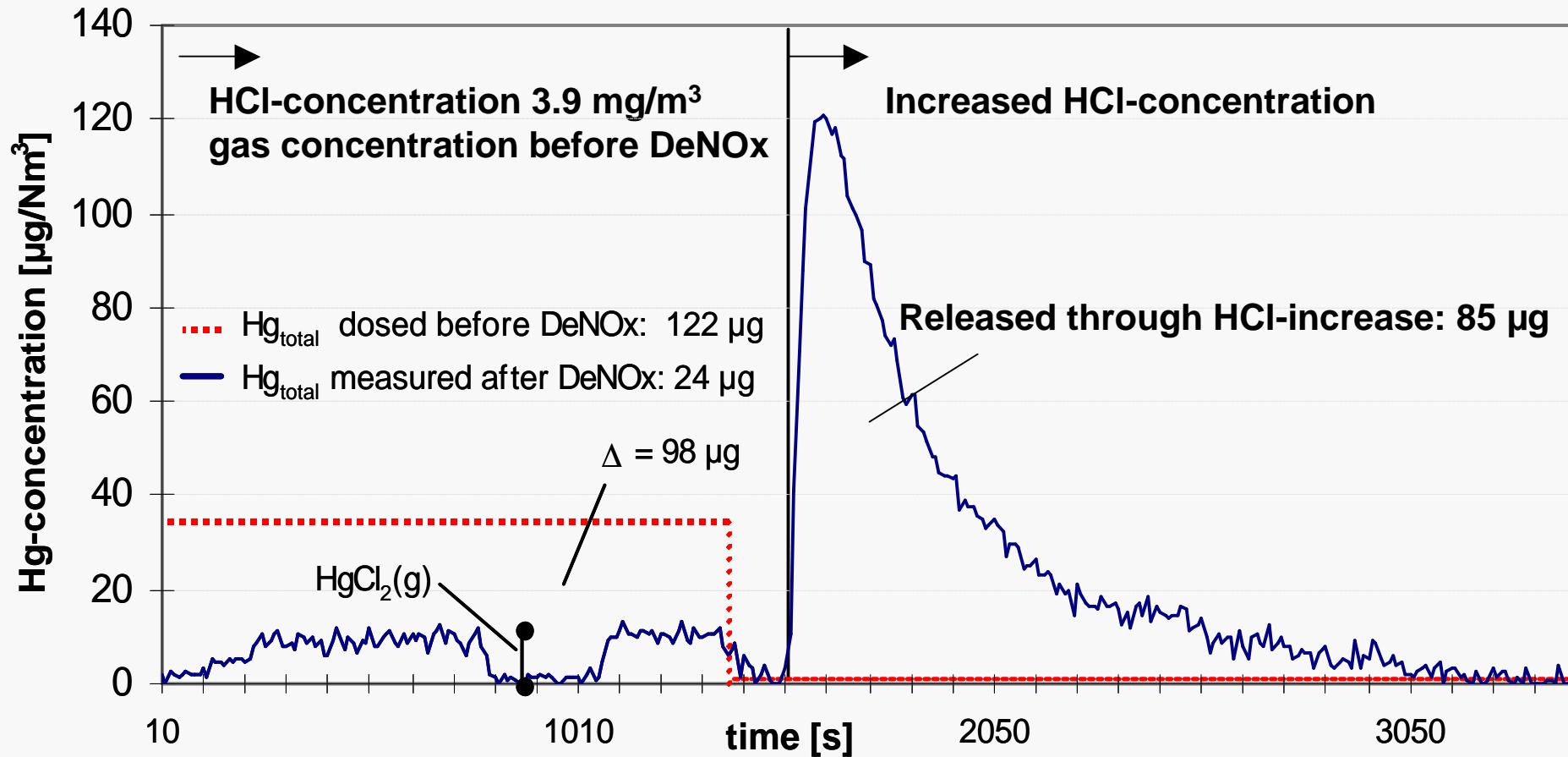


Test Conditions

- SCR-DeNOx-catalysts (Typ Ti/V) are evaluated in order to determine their adsorption and oxidation behavior for mercury
 - Hg (HgO , Hg^0 , HgCl_2) is injected into the reactor
 - N_2 , O_2 , H_2O , HCl and SO_2 is added
 - Flue gas is heated up to 380°C
 - Hg species analysis using Hg-CEM and adsorption resin for HgCl_2

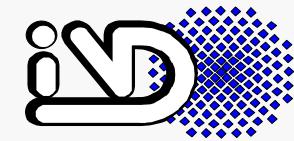


Typical Behavior of Hg at SCR-Catalysts

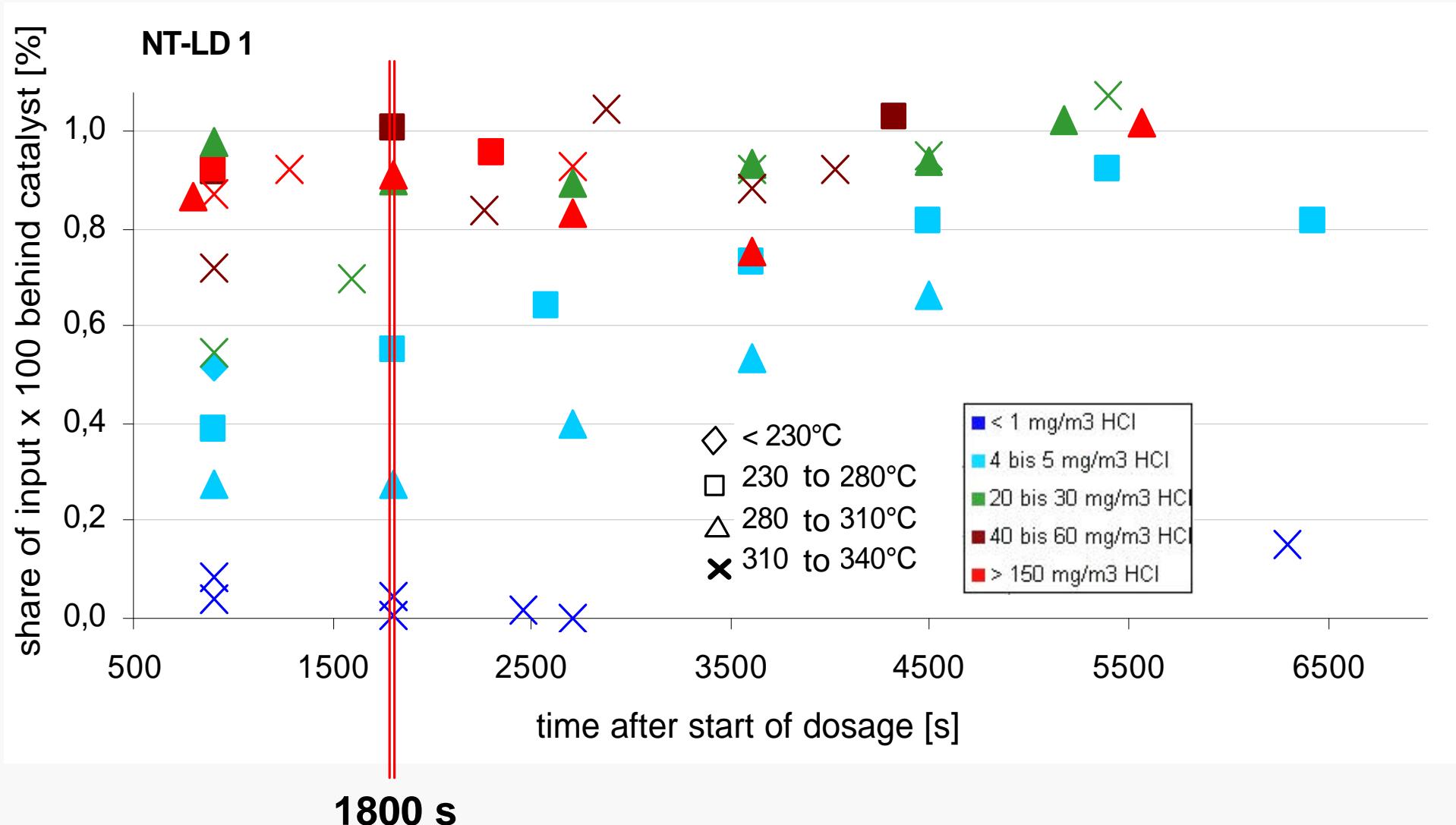




Sorption of Hg at Catalyst (NT-LD 1)

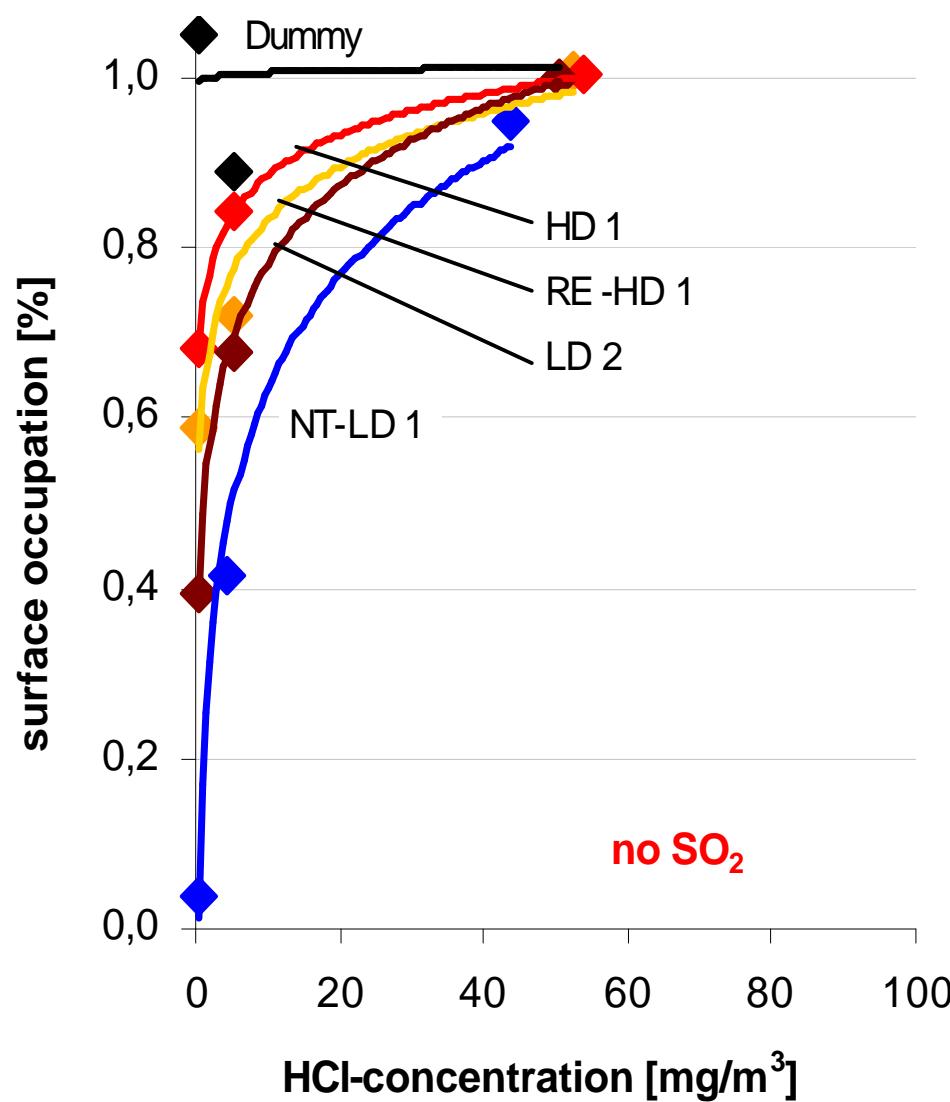


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Degree of Surface Occupation at 330°C



$$\text{surface occupation } q = \frac{c_{Hg\ out}}{A}$$

Gas composition:

Hg: ca. 20 µg/m³

O₂: 1,7 to 1,85 Vol.-%

H₂O: 2,9 to 4,0 Vol.-%

HCl: between

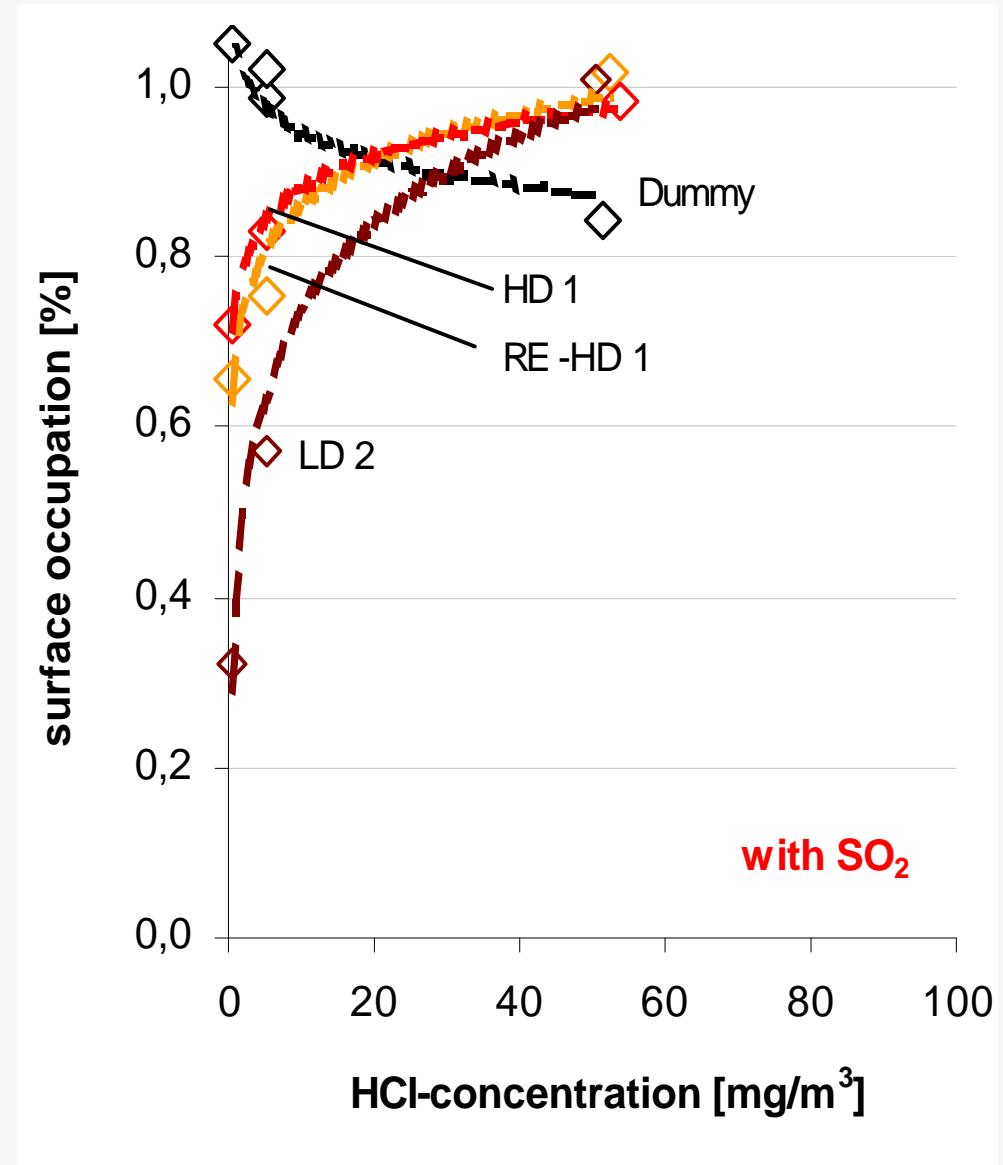
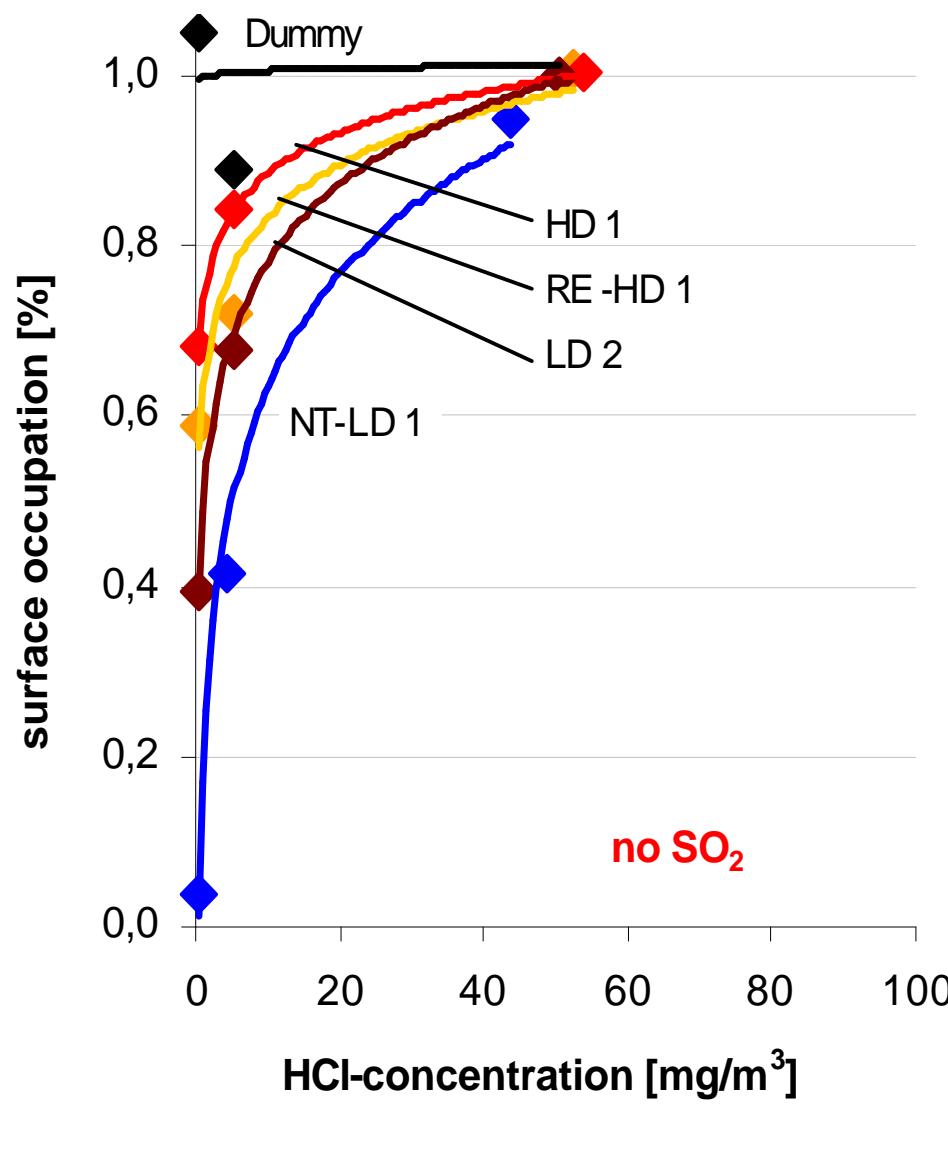
0,5 and 120 mg/m³

N₂: rest

- surface occupation HCl-dependent:
 - sufficient HCl:
low to negligible occupation
 - little HCl:
occupation catalyst type dependent



Degree of Surface Occupation at 330°C





Conclusion (1) – tail-end application of SCR

- SCR-DeNOx-catalysts (Typ Ti/V) could act as a „buffer“ for mercury. Promoting circumstances are:
 - HCl-concentrations: < 10 mg/m³
 - temperature range: 230°C < T < 340 °C (so far tested)
- ✓ given at **tail-end** catalysts with upstream HCl/SO₂ separation. Adsorption/Desorption behavior has been observed at german MSW-incinerator.



Conclusion (2) – tail-end application of SCR

- Adsorbed Hg can be released through changing flue gas composition or temperature variation.

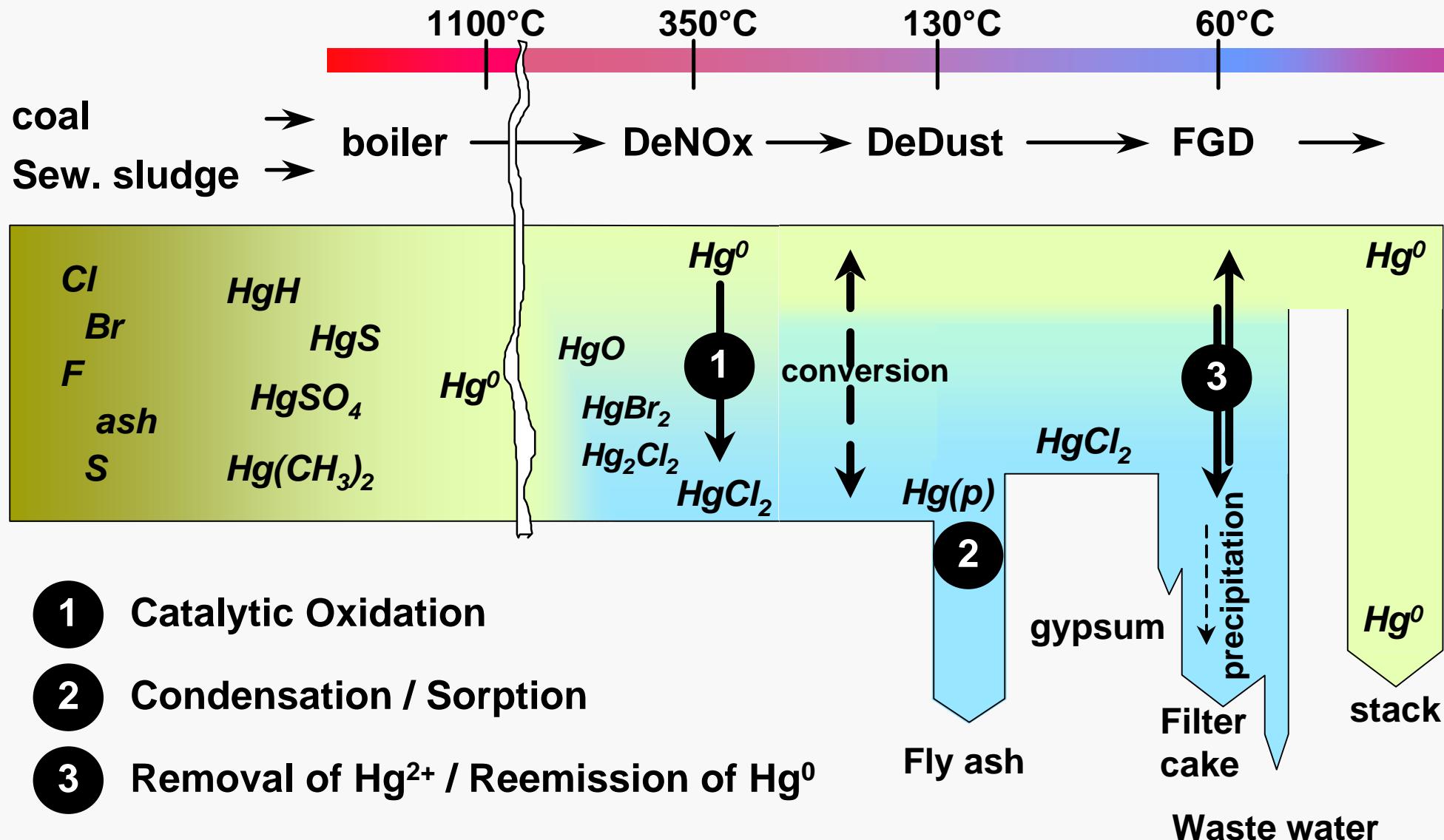
- Identified trigger mechanism:
 - (temporary) increase of **HCl**-concentration leads to a spontaneous desorption / asymptotic curve
 - contribution of other flue gas components expected



High-dust Application of SCR – Hg Behavior

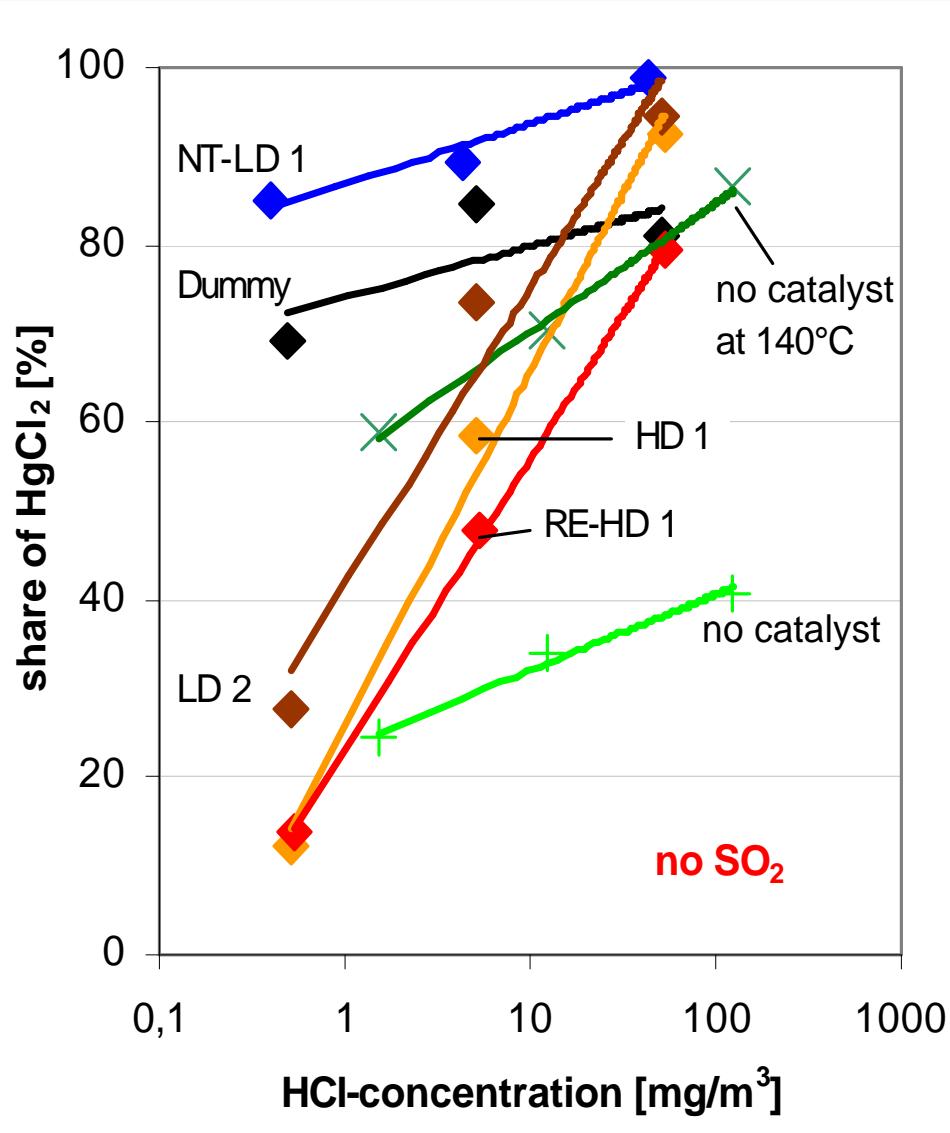


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Influence of HCl on Mercury Oxidation



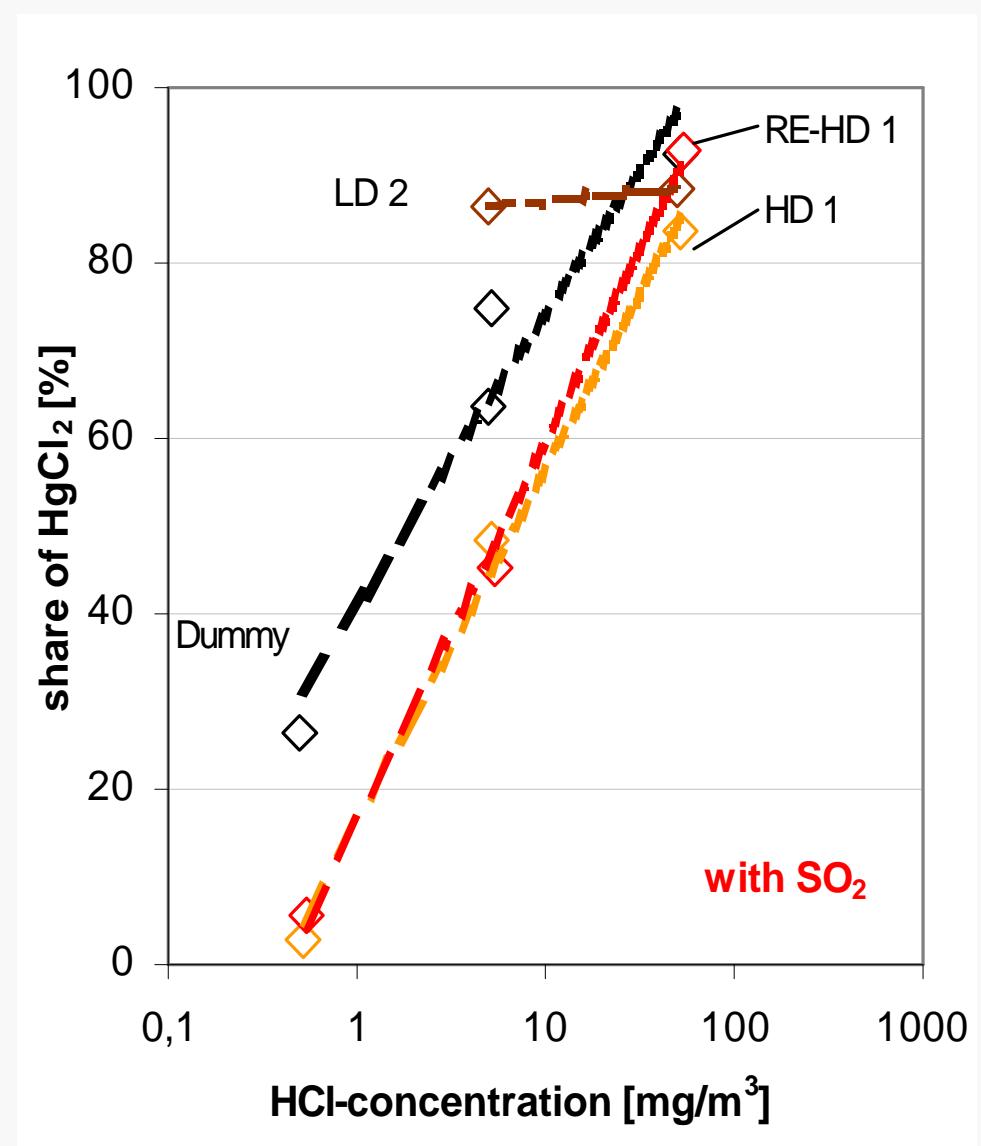
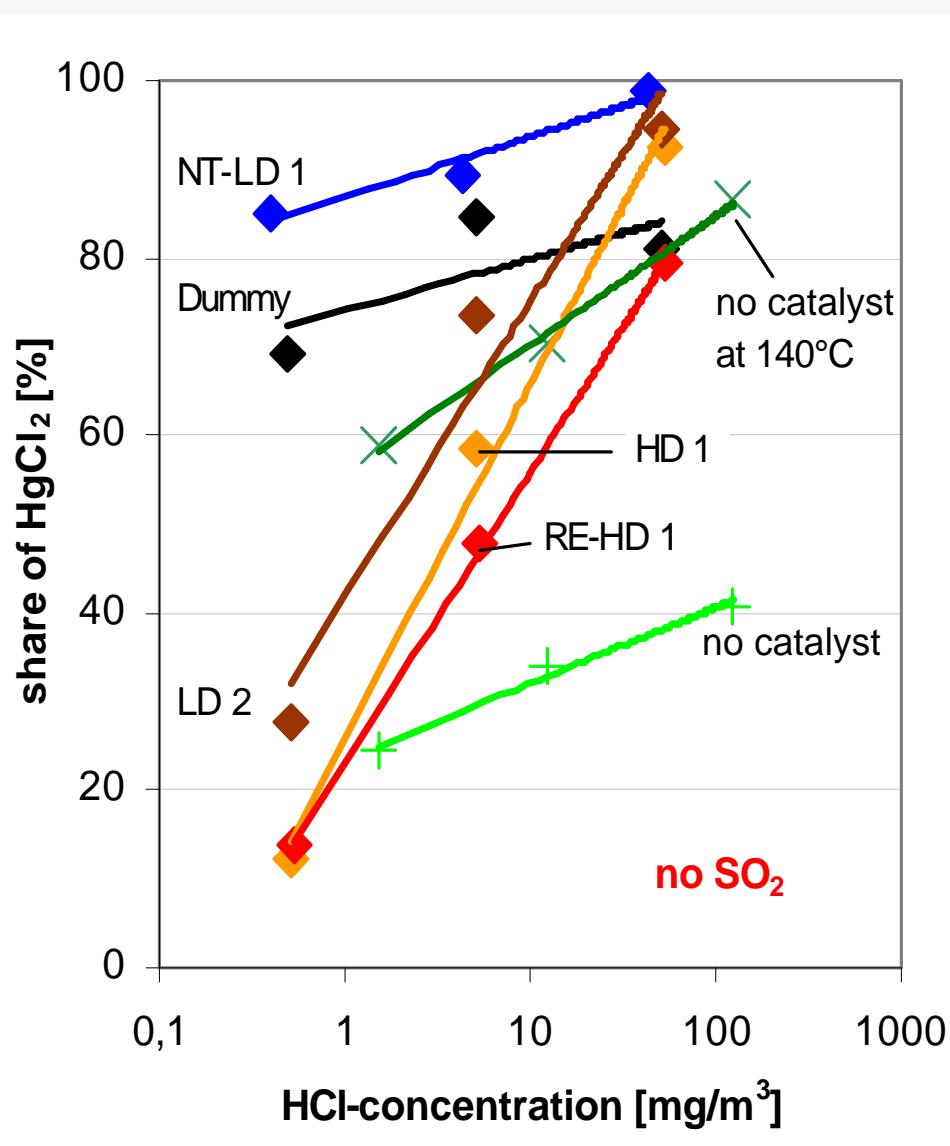
Gas composition:

Hg: ca. 20 $\mu\text{g}/\text{m}^3$
O₂: 1,7 to 1,85 Vol.-%
H₂O: 2,9 to 4,0 Vol.-%
HCl: Variable between
0,5 and 120 mg/m^3
N₂: rest

Temperature: 330°C



Influence of HCl on Mercury Oxidation

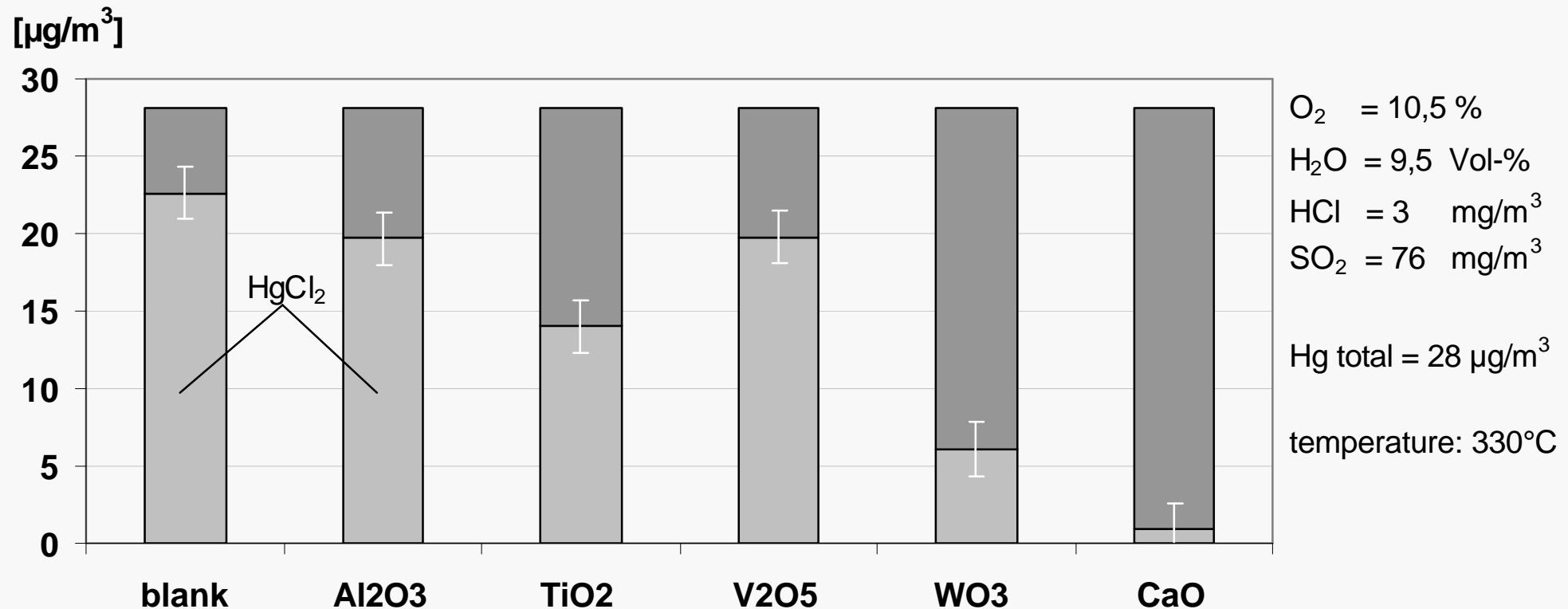




Influence of Single Catalyst Components



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Concl. (3) – high-dust application of SCR

- Share of HgCl_2 behind catalyst dependent on **HCl** concentration:
 - sufficient high **HCl**-concentration leads to almost complete oxidation to HgCl_2
 - low **HCl**-concentration leads to incomplete oxidation where HgO is supposed to be an intermediate oxidation stage.



Future Work

- Evaluate oxidation mechanisms at DeNOx catalysts
- Verify oxidation of elemental mercury at catalysts
- Evaluate long-term oxidation behavior of catalysts
- Evaluate influences from fly ash

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